REMARKS

This amendment is submitted in response to the office action of April 4, 2003 in which all of the claims were rejected on the art, and in which claim 25 was objected to in view of a typographical error. It was also noted that the Form 1449 was missing from the IDS entered in the office file.

In accordance with the Examiner's request, we are attaching a copy of the Form 1449 from our file, along with the postcard receipt indicating that this form had been sent.

The Amended Clams

Clarifying and editorial amendments are made to claim 1 (the sole independent claim) and to dependent claims 7, 8, 12, 9, 16 and 22 - 28. The Amendments relate to form and correct typographical errors. As will be apparent from their context, these amendments are not made for purposes of patentability or for distinguishing the prior art applied in the office action. No additional limitations are entered in claim 1.

The Claims Are Not Obvious in View of the Art

We have carefully considered the *prima facie* case of obviousness asserted in the office action that is based on the disclosure of USP 3,444,072 ("Lehman") alone, and also on Lehman in combination with the disclosure of USP 5,414,168 to Scott ("the Scott patent"). However, when the limitations of applicants' amended claims are analyzed in the context of the overall thermodynamic and physical limitations of the hydrogen separation and recovery process of the

invention, it will be apparent that those limitations define a patentably distinct process. Reconsideration of the amended claims in view of the following analysis and arguments is therefore respectfully requested.

Lehman's Process is Functionally Different Than The Process of Applicant's Claims

Applicants appreciate the Examiner's recognition of other important differences between the present process and that of the Lehman disclosure. In fact, not only is Lehman silent about applicants' preferred C_4-C_5 hydrocarbon absorption solvent, Lehman teaches away from the need to purify hydrogen to the level claimed by applicants.

Throughout the Lehman disclosure is concerned with "minimizing" loss of hydrogen (col. 1, lines 2, 14, 26, 32-33, 44, 61-62; col. 3, lines 25-27). Lehman does recognize in column 2, lines 23-25 that in recycle systems provisions must often be made to prevent build-up of volatile impurities in the recycle gas. As stated by the applicants on page 3, lines 7-16, in the processes of the prior art, up to 2% of the recycle flash gases containing 78 to 82 mol% H_2 from the ambient temperature high pressure separator are purged to the fuel gas system to prevent build up of the light hydrocarbon products in the reactor recirculation loop.

To reduce this loss of hydrogen, Lehman applies ambient temperature absorption by removing some of the lighter volatiles and returning the associated hydrogen to the reactor. In fact, Lehman returns hydrogen containing stream 86 from the first flash drum 74 to join the make-up hydrogen (col. 4, lines 56-58), regardless of its purity. With Lehman's ambient temperature feed to the absorber, lean oil, enriched with volatile contaminants leaving the bottom of the absorber will be warmer than the feed gas because of the heat of absorption effect, which

occurs upon pressure let-down, first to 125 psig and then to 20 to 60 psig (col. 4 lines 55-64), and then subsequently being pumped by pump 85 warms up because of heat of pumping to become essentially at ambient temperature. With the lean oil entering the absorber at ambient temperature, the overhead gases from the absorber are warmer than the ambient temperature, at which, if C_4-C_5 were used as the solvent, would result in a large loss of these components because of their high vapor pressure, thereby requiring a constant make-up of lean oil, which is neither indicated nor desired by Lehman. To a person of ordinary skill in the art, preferred lean oils for ambient temperature absorption have molecular weights on the order of 140 to 150, which compared to C_9-C_{10} lean oil, have a low vapor pressure. Thus, Lehman's process teaches away from the use of applicants' claimed C_4-C_6 solvent.

The Claimed Process Produces a Hydrogen Stream of Significantly Greater Purity than Lehman

The present invention provides an improved process for recovering from a gaseous mixture of hydrogen, methane and heavier hydrocarbons and, optionally, hydrogen sulfide, a hydrogen stream that is at a purity of from 90 to 98 mol percent hydrogen. This limitation of the hydrogen content of the gas stream from the absorber is set forth in sub-paragraph (b) of claim 1.

Applicants' process provides a substantial increase in hydrogen recycle gas purity when compared to the overhead stream from Lehman's absorber 60 that contains only 70% - 80% hydrogen by volume (col. 4, ll. 46-50). Thus, Lehman's recycled gas stream 50 returns to the feed of the hydroprocessor unit of reactor 26, a substantial portion of the hydrocarbon gases with

the hydrogen. Recycling hydrocarbons as feed reduces efficiency and also establishes the requirement for a larger volume of make-up hydrogen from input process stream 10. This advantage of the process in terms of purity of the incoming hydrogen stream to the processor of the current invention provides a significant cost savings.

It is also to be noted that Lehman discloses sending vapors from flash drums 74, 76 and 78 back to the reactor because they "contain substantial amounts of hydrogen gas". Although not specifically stated, it is apparent to one of ordinary skill in the art that these streams also comprise substantial amounts of hydrocarbons, which as a percent, would be much greater than he 20%-30% of absorber off-gas stream 50.

The Claimed Operating Temperatures
Are Not Suggested by Lehman

The Office Action asserts that Lehman discloses steps corresponding to applicants' cooling of an effluent gas, and further, that cooling of the effluent gas to "ambient" temperature is considered to encompass applicants' temperature limitations of 0°F to -20°F under claims 11-12.

We respectfully traverse this assertion and direct the Examiner's attention to page 18, line 2 to page 19, line 7 of the application where three different ways are described that cool the reactor effluent gases to "ambient" temperature. Applicants submit that, to persons skilled in the art, ambient temperature in the refinery arts means the range of 100°F to 140°F and can be achieved through utilization of either a cooling water system or an air cooler system. The steps described on pages 18-19 of this application are not suggested by, and are contrary to the Lehman's "ambient" cooling steps.

A refrigeration system is not required to achieve ambient temperatures. Nowhere in the Lehman disclosure is there any indication of the need for a refrigeration system. As stated by applicants (page 21, lines 19-23), the ambient temperature gas stream is chilled with a refrigerant chiller to the desired temperature in the range from 30°F to -40°F. All of these temperatures are below the freezing temperature of water and would not be considered by one of ordinary skill in the art to be within the range of "ambient" temperatures taught by Lehman.

The extent to which Lehman teaches "cooling" of the effluent gas stream must be considered in its context. As is clear from the present disclosure (beginning at p. 21, l. 12 to p. 22, l. 6), the temperature of applicants' effluent gas stream 24 is initially at ambient conditions and is chilled by heat exchangers to a temperature in the range of between 30°F/-1.1°C and -40°F/-40°C, the most preferred operating range being the range of -10°F/-23.3°C to -15°F/-26.1°C. This is in sharp contrast to Lehman's process, where the hydrogen-containing vapors entering the absorber are reduced only to ambient temperature (col. 4, ll. 25-28).

Accordingly, Lehman does not teach chilling gases below the freezing temperature of water prior to the absorption step as required by applicants' claims. Reconsideration and withdrawal of the rejection of the claims on this basis is respectfully requested.

Lehman Teaches Away From
Applicants' Choice of Solvent

A further important distinction between the operating conditions disclosed by Lehman and those of the applicants' claimed process is the C_1+ hydrocarbon-absorbing solvent. Lehman discloses the use of an "oil" 70 (col. 4, ll. 43-46), which is recovered and recycled from the

flash drums 74 and 78 to the absorber 60 via line 70 (col. 4, ll. 51-64). However, there is no specific teaching of the composition of this lean "oil". The only other descriptions of the absorbent solvent provided by Lehman appear at col. 2:

> "...impurities are removed by absorption in a suitable lean oil" (lines 14-17)
>
> "If this lean oil is flashed at intermediate pressures, substantial proportions of this hydrogen can be recovered." (lines 32-24)

Lehman obviously considered the selection of the "lean oil" for use in his absorber 60 to be a routine matter for one of ordinary skill in the art at the time of filing in 1967. However, it is not clear form Lehman's disclosure whether the oil is a minerally-derived oil or whether a vegetable oil (or even an animal oil, e.g., whale oil, should be used.

Applicants' process is strikingly different. It operates using an absorbent solvent stream comprising C_4 to C_5 hydrocarbon components that are contained in, and derived from the separated effluent gas stream drawn from the reactor 12. By no stretch of the usage in the art would one of ordinary skill consider these butane (C_4) and pentane (C_5) components to be classified as "lean oils". Therefore, it cannot be asserted that Lehman's disclosure could render the choice of applicant's claimed absorber solvent obvious. Reconsideration withdrawal of the rejection on this basis is respectully requested.

Applicants' Solvent Stream is Derived From the Feed

A further patentably significant limitation of the claimed process requires that the solvent be derived from the components present in the separated effluent gas stream. We respectfully

submit that this is a significant and non-obvious departure from the process disclosed by Lehman and is one which further supports the patentability of the amended claims. Lehman's "lean oil" (whatever its composition), must be added to the system and, over time, will have to be replenished and possibly replaced. In contrast applicants' solvent is actually derived from the effluent stream.

Applicants' Operating Pressure Conditions
Are Neither Disclosed nor Suggested by Lehman

Contrary to the assertion in the Office Action, Lehman does not state in column 5, lines 22-26 that the absorber pressures are 0.2 to 0.75 of the system pressure. Rather, Lehman states that the vaporous effluent, produced from flashing the reaction temperature liquid to 0.2 to 0.75 of the system pressure under step (c) of claim 1, is cooled to separate a condensed liquid which is further flashed at a pressure of 0.2 to 0.75 of the system pressure. The separated cooled vapors under claim 6, (col. 5, lines 47-54), is passed through an absorption stage in the presence of an absorption oil and the absorber oil is flashed at a pressure of 0.2 to 0.75 of the system pressure. It is not clear at what pressure the absorption is occurring, but it does not occur higher than a pressure of 0.75 of the system pressure.

In the process of the present invention, as illustrated in Figs. 3 and 4, the hydrocracking operation is maintained at 2500 psig and the high pressure (HP) separator 20 operates at 2400 psig. (p. 17, lines 4-6). Further, the preferred absorption under this invention occurs at about 2400 psig, the operating pressure of the HP separator 20 (page 21, line 9 through page 22, line 8). With a 100 psi pressure drop between the hydrocracking reactor operating in the range of 500 psig to 5000 psig (page 26, line 23), and more preferably in the range of 1000 psig to 3000

psig (page 27, lines 1-2), and the HP separator, the absorber of this invention operates at 400/500 = 0.8; 4900/5000=0.98; or more preferably at 900/1000 = 0.9 and 2900/3000 = 0.97 of the system pressure. Accordingly, the absorption pressure range of this invention of 0.8 to 0.98 is clearly outside the Lehman range of 0.2 to 0.75 of system pressure. Accordingly, Lehman does not teach operating the absorption in the pressure ranges taught by applicants.

The Combined Teachings of Lehman and Scott Cannot Render Applicants' Process Obvious to One of Ordinary Skill in the Art

Contrary to the Examiner's assertion that Scott teaches the suitability of C_4 - C_6 hydrocarbons for extracting hydrocarbons from a gas to produce hydrogen off gas under the cited reference at column 8, lines 55-60, Scott's is limited to teaching the use of C_4-C_5 **paraffinic** hydrocarbons (not C_4-C_5 hydrocarbons generally) for extraction, with the additional proviso that the cold lean liquid absorbent enter the top of the absorber column maintained at very cold temperatures of less than about -120°F, preferably less than about -200°F, most preferably less than about -250°F. Additionally, the suitable pressure for Scott's cold absorption zone can be about 100 psig (col. 8, lines 63-68 and col. 11, lines 23-30).

On a closer examination of the Scott process as illustrated in the figures C_2-C_5 paraffins are introduced into the process through stream 2 which are first cooled to -120°F in stream 8, mixed with recycle hydrogen from stream 11, reheated to 80°F prior to dehydrogenation reactor in unit 4. The effluent from the dehydrogenation reactor is chilled to -120°F in stream 16 and separated from hydrogen-containing vapor phase (col. 11, lines 13-14) in a vapor liquid separator 22 operating at 100 psig and -120°F. Exiting the bottom of separator 22 in stream 24

is a liquid phase comprising a substantial amount of C_2-C_5 olefinic hydrocarbons as well as unreacted paraffinic hydrocarbons (col. 10, lines 48-53).

At the operating conditions of -120°F and 100 psig in Scott's vapor-liquid separator 22 (col. 10, lines 48-50), it is highly unlikely that any contained C_4-C_6 hydrocarbons as part of the C_4-C_5 hydrocarbons (be they olefinic or paraffinic) will leave with the hydrogen-containing vapor phase, since substantially all of these have left the system as part of liquid stream 24. Also, the cold methane-rich liquid absorbent exits the bottom of the absorber at about -250°F (col. 11, lines 30-32), the hydrogen-containing vapor phase consists essentially of hydrogen and methane. Therefore, Scott's preferred paraffinic C_2-C_5 solvent containing if any C_4-C_5 is not derived from the feed as required in the claims of applicants' process.

Even though Scott states that the cold lean liquid absorbent stream entering the cold absorber that is maintained at -250°F and 100 psig (col. 11, lines 24-27) is comprised of C_2-C_5 paraffinic hydrocarbons, it is unlikely that any significant amount of C_4-C_5 hydrocarbons are present as part of the cold lean absorbent steam, since the operating temperature of Scott's absorber is very close to, or less than the freezing point of C_4-C_6 hydrocarbons. In order for Scott to effectively extract methane from the hydrogen at -250° in the cold absorber, the <u>C_2-C_6 lean absorbent is predominantly C_2 hydrocarbons with some C_3 hydrocarbons and most importantly, no significant quantity of C_4-C_5 hydrocarbons are likely to be present.</u>

Therefore, Scott does not teach the use of C_4-C_5 hydrocarbons for the purification of the hydrogen stream. Nor does Scott teach purification of the hydrogen-containing stream at applicants' temperature range of 30°F to -40°F and at the significantly higher pressures from 200 psig to 5000 psig that are common to hydroprocessing processes (page 27, line 7).

As previously indicated, Lehman is concerned with the minimization of hydrogen loss and not its purity. Simply circulating more lean oil at ambient temperatures cannot lead to a higher purity of hydrogen beyond 70-80% by volume (col. 4, line 47) since the absorber overhead stream reaches equilibrium with the ambient temperature lean oil. The solubility of the lighter volatile contaminants at ambient temperature thereby limits the purity of the hydrogen recycle steam.

Reconsideration and withdrawal of the refusal on the basis of Scott in combination with Lehman is respectfully requested.

Applicants Have Overcome any *Prima Facie* Case of Obviousness Raised in the Office Action

It is well-established that the burden of establishing obviousness remains with the Office during the examination of the claims. To the extent that a *prima facie* case of obviousness was established with respect to the original examination, we respectfully submit that it has been overcome by the detailed analysis of the prior art relied upon when applied to the amended claims.

When the proper interpretation is applied to the references relied upon, it is apparent that there is no teaching of the use of C_4-C_5 hydrocarbons for absorbing methane and lower hydrocarbons to provide a hydrogen recycle gas stream of 90-99 mol% purity at significantly higher pressures on the order of 200 to 5000 psig at relatively milder refrigerated temperatures range of 30°F to -40°F with solvent generated from the feed with no external solvent make-up.

More importantly, no motivation for making the numerous changes that would be required can be found in any one or combination of the prior art references, including those made of record and not specifically relied upon.

It must be kept in mind that the assertion of obviousness under §103 cannot rely upon an improper hindsight analysis that is based upon the applicant's disclosure. *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.,* 230 USPQ 416, 419 (CAFC 1986). A similar stricture applies to attaching improper significance to isolated statements appearing in references, particularly as in the Lehman and Scott references discussed above. As the former Court of Customs and Patent Appeals held:

> "It is impermissible within the framework of §103 to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art."

In re Wesslau (147 USPQ 391, 393)(CCPA 1965).

In another early case, the CCPA characterized the fundamental error of the Board and the Examiner...to have arisen from their analysis of the art as if it contained the knowledge of Appellant's invention." *In re Aufhauser, 158 USPQ 351, 353 (CCPA 1968).* Thus, the obviousness of an invention may not be determined by analyzing the prior art as though the applicants' invention was included as part of the knowledge possessed by one of ordinary skill in the art. Under §103, teachings of references can be combined only if there is some suggestion or incentive to do so. *ACS Hospital System, Inc. v. Montefiore Hospital, 221 USPQ 929, 933 (CAFC 1984).* Put another way:

> "It is impermissible to use the claimed invention as an instruction manual or "template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious. This Court

has previously stated that "one cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention".

In re Fritch, 23 USPQ 2d, 1780 (CAFC 1992).

Conclusion

Based upon the above analysis of the prior art and the claimed invention, we respectfully submit that any *prima facie* case of obviousness that might have been made out in this first office action has been overcome.

We therefore respectfully request favorable reconsideration and allowance of the claims.

Respectfully submitted,

ABELMAN, FRAYNE & SCHWAB
Attorney for applicant

By Thomas E. Spath

Thomas E. Spath
Reg. No. 25,928
150 East 42nd Street
New York, NY 10017

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